Standard C-4: The student will demonstrate an understanding of the types, the causes, and the effects of chemical reactions.

Supporting Content Web Sites

Virginia Tech Department of Chemistry
http://www.chem.vt.edu/RVGS/ACT/notes/Types_of_Equations.html
Provides a summary of the types of chemical reactions expressed as chemical equations with links to practice on balancing equations. Includes using an activity series for single replacement equations and predicting products of simple equations including combustion.
C-4.1, C-4.2

NOVA Online Fireworks: On Fire
http://www.pbs.org/wgbh/nova/fireworks/fire.html#
Provides a link to either a *Flash* or non-*Flash* version of an interactive review of a combustion reaction from the striking of a match to an atom by atom rearrangement of the molecules to create the products.
C-4.2

Iowa State University: Metals in Aqueous Solutions
http://www.chem.iastate.edu/group/Greenbowe/sections/projectfolder/flashfiles/redox/home.html
Interactive simulation in which students choose metals to place into solutions in order to create a reactivity series. Choosing the "molecular scale reactions" will show an animation of the electron exchange process.
C-4.1, C-4.7

Iowa State University: Voltaic Cell
http://www.chem.iastate.edu/group/Greenbowe/sections/projectfolder/flashfiles/electroChem/voltaicCellEMF.html
Interactive simulation of a voltaic cell in which students choose the electrodes and the solutions. Ions visually move within the solutions.
C-4.8

Iowa State University: Conductivity
http://www.chem.iastate.edu/group/Greenbowe/sections/projectfolder/flashfiles/electroChem/conductivity.html
Interactive simulation of a conductivity experiment in which students control the electrolyte solution and the concentration of the solution to illuminate a light bulb.
C-4.8

Iowa State University: Equilibrium
http://www.chem.iastate.edu/group/Greenbowe/sections/projectfolder/animations/no2n2o4equilV8.html
Simulation of an NO_2/N_2O_4 equilibrium. Students are directed to notice the changes in specific molecules and then to compare the number of each molecule at several stages.
C-4.9

Jefferson Lab: Balancing Act
http://education.jlab.org/elementbalancing/index.html
Interactive site in which students select the number and difficulty level of chemical equations to balance by choosing the correct coefficient from drop-down boxes. Answers are checked by the program and incorrect coefficients are highlighted for corrections.
C-4.1

Fun-based Learning: Chembalancer
http://funbasedlearning.com/chemistry/chembalancer2/default.htm
Students are provided chemical equations to balance by inserting the correct coefficients, and then as the coefficients are added, visual representations of the number of atoms are displayed. When students check their answers, a description of the importance of that chemical reaction in everyday life appears.
C-4.1

University of California-Irvine: Chemical Kinetics
http://www.chem.uci.edu/undergrad/applets/sim/simulation.htm
An applet that runs in real time showing the redistribution of simulated molecules to create a dynamic equilibrium. It is accompanied by a link to an instructions page where students will find a complete explanation of the simulation.
C-4.9

Suggested Literature

Keeler, J. (2003). *Why chemical reactions happen*. Oxford, UK: Oxford University Press.
ISBN: 0-19-924973-3
Lexile Level: Not available
Describes the way in which the concepts in a first year chemistry course are interconnected to create the conditions that cause a chemical reaction to occur. Students will enjoy the "story-line" format that emphasizes the major components of a chemical reaction rather than the mathematical details of the reaction mechanism.

Cobb, C. & H. Goldwhite (1995). *Creations of fire: chemistry's lively history from alchemy to the atomic age.* New York: Perseus Books Group.
ISBN: 0-7382-0594-X
Lexile Level: Not available
Students will find this an engaging illustration of the development of modern chemistry from the inexact practice of alchemy. The book provides descriptions of the way the tools and recipes of the ancient alchemists became the symbolism, equipment and reaction procedures of modern chemists, often relatively unchanged.

Suggested Streamline Video Resources

Simply Science: Combustion and Replacement Reactions
Combustion
ETV Streamline SC
Discussion of the combustion reaction using cellular respiration and the burning of fossil fuels to produce energy as examples. Includes an explanation of balancing a combustion equation and presents both complete and incomplete combustion products. Also presents a short discussion of the energy of collisions as a necessity for igniting a material.
6:38
C-4.1, C-4.2, C-4.3, C-4.10

Simply Science: Combustion and Replacement Reactions
ETV Streamline SC
Provides details and examples of both single and double replacement reactions with an explanation of balancing chemical equations of each type. Discusses the role of a solubility chart in determining which of the resulting products in a double replacement reaction will not be aqueous.
18:05-26:17
C-4.1

Chemistry Connections: Introduction to Thermochemical Changes
Endothermic and Exothermic Reactions
ETV Streamline SC
Gives several examples of both endothermic and exothermic reactions with a discussion of the energy changes in each. Most examples are based in real-world applications.
9:08
C-4.3

Chemistry Connections: Energy from the Sun
Catalysts
ETV Streamline SC
Uses the burning of a sugar cube dipped in acid, the decomposition of hydrogen peroxide, a car's catalytic converter, and CFC depletion of the ozone layer as demonstrations of the role of a catalyst. Provides a detailed discussion of the sugar reaction with an explanation of an energy diagram and activation energy.
6:32
C-4.6

Chemistry Connections: An Introduction to Oxidation and Reduction
ETV Streamline SC
Begins with a discussion of the extraction of metal from ores as in introduction to oxidation and reduction reactions. Provides examples of electrolytic and voltaic cells (though they are not named as such), balancing with half-cell reactions, and determining oxidizing and reducing agents.
29:05
C-4.7, C-4.8

Chemistry Connections: Dynamic Equilibrium
Forward and Reverse Rates in Concentration
ETV Streamline SC
A comical simulation of a reversible reaction that helps students understand a dynamic equilibrium. The simulation is accompanied by on-screen graphics using chemical symbolism to compare the forward and reverse rates.
4:17
C-4.4, C-4.9

Chemistry Connections: Opposing Reactions and Le Chatelier's Principle
ETV Streamline SC
Presents the Haber-Bosch process for producing ammonia and an analogy of people in a building as a means of explaining Le Chatelier's Principle. Also includes a demonstration of cobalt (II) coordination complexes with detailed analysis and a discussion of the use of a catalyst.
29:05
C-4.6, C-4.9

Career Connections

Chemical engineer
Chemical engineers develop and monitor chemical processes by determining the best reactants, reaction mechanisms, and reaction conditions (time, temperature, etc.) for producing the greatest yield of a desired product in the most efficient manner. Chemical engineers prepare written proposals and make presentations of their recommendations.

Chemical technician
Chemical technicians work with a chemist or chemical engineer to operate standard laboratory equipment. They set up apparatii for chemical reactions, perform chemical tests, and monitor reactions by checking quality of products, performance of equipment, and compliance with safety and pollution control standards. Chemical technicians are responsible for maintaining thorough and accurate laboratory records.

Electrolytic plating operator
Electrolytic plating operators run electrolytic plating or coating machines to coat metal or plastic products with chromium, zinc, copper, cadmium, or other metals to provide protective or decorative surfaces or to repair worn surfaces.

Catalytic chemist
Catalytic chemists specialize in the study of chemical reaction catalysts. Some are involved in the research and development of new catalysts or new uses of existing catalysts while others concentrate on the application of catalysts to chemical synthesis or industrial processes.

Pulp and paper chemist
Pulp and paper chemists specialize in the chemical processes required to produce paper products from wood pulp. They develop and monitor chemical reactions that extract the cellulose from pulp, bleach and dye the paper, size the paper for surface characteristics, and regulate the desired strength of the paper for a given application.